rains would greatly benefit the condition of wheat and other fall grainl Cotton picking has been completed in all sections, except for smal. scattered patches.—*Edward H. Bowie.*

Utah.—The mean temperature was 41.3°, or 4.0° above normal; the highest was 76°, at Green River on the 1st, St. George on the 3d and 4th, and at Fillmore on the 8th; and the lowest, zero, at Loa on the 11th. The average precipitation was 0.29, or 0.55 below normal; the greatest monthly amount, 1.40, occurred at Heber, while none fell at ten stations.

One of the warmest Novembers on record. The continued dry weather has not been favorable for fall grain. Feed and water are very scarce on the ranges, and as a result sheep are in very poor condition.—*L. H. Murdoch.*

Virginia.—The mean temperature was 41.2°, or 5.6° below normal; the highest was 84°, at Barboursville on the 1st, and the lowest, 11°, at Buckingham and Burkes Garden on the 19th. The average precipitation was 1.48, or 1.31 below normal; the greatest monthly amount, 2.62, occurred at Lincoln, and the least, 0.20, at Newport News.

The month was too cold and dry for the growth or the early seeding of winter grains, also for the germination of late seeding. Many fields seeded to winter wheat late in the season are still bare, and it is thought the seed has rotted. Winter oats and clover behind their average seasonal condition. Fall plowing suspended until after rains of 23–24th.—*Edward A. Evans.*

Washington.—The mean temperature was 44.0°, or 3.3° above normal; the highest was 77°, at Mottinger's on the 4th, and the lowest, 9°, at Wilbur on the 3d. The average precipitation was 6.10, or 0.36 above normal; the greatest monthly amount, 23.68, occurred at Clearwater, and the least, 0.35, at Connell.

The mildness of the month, and sufficiency of rain contributed to the growth of winter wheat, which throughout the month was in very favorable condition. The rain improved pastures and put the soil in good condition for plowing.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 38.0°, or 6.2° below normal; the highest was 79°, at Mannington on the 1st, and the lowest, 7°, at Beverly on the 29th. The average precipitation was 2.51, or 0.63 below normal; the greatest monthly amount, 5.35, occurred at Mannington, and the least, 1.23, at Lewisburg.

At the close of the month, early sown wheat, where not injured by the fly, was in fair condition, but the later sown (and most was such) was in rather poor condition, and some had been killed.—*E. C. Voss.*

Wisconsin.—The mean temperature was 32.0°, or 0.5° below normal; the highest was 73°, at Prairie du Chien on the 12th, and the lowest, 8° below zero, at North Crandon on the 26th. The average precipitation was 0.84, or 0.90 below normal; the greatest monthly amount, 1.87, occurred at Osceola, and the least, 0.22, at Prentice.

The weather during the month was very favorable for winter grains and grasses. Winter wheat amd rye have continued to make good progress and are now generally considered to be in excellent condition. The deficiency in precipitation has caused a low stage of water in most streams, and the soil, especially in the southern portion of the State, is in need of moisture.—*W. M. Wilson.*

Wyoming.—The mean temperature was 37.1°, or 4.7° above normal; the highest was 82°, at Bitter Creek on the 9th, and the lowest, 8° below zero, at Big Piney on the 13th, 18th, and 19th. The average precipitation was 0.32, or 0.31 below normal; the greatest monthly amount, 1.25, occurred at Fort Yellowstone, while none fell at Hyattville.

The month was unusually mild and free from any severe storm. The weather was very favorable for all stock, which is still in excellent condition. The absence of snow prevented many sheep from being moved to winter ranges away from the streams, and compelled them to be fed on the summer ranges, which now furnish poor grazing.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

THE WESTWARD MOVEMENT OF THE DAILY BAROMETRIC WAVE.[1]

By OLIVER L. FASSIG, Ph. D., Section Director, United States Weather Bureau.

The publication, in recent Annual Reports of the Chief of the Weather Bureau, of the hourly values of barometric pressure at a large number of stations in the United States, in the West Indies, and along the north coast of South America affords an excellent opportunity for the study of the diurnal variations of the barometer over a wide area. Reliable hourly observations in the middle and higher latitudes of South America are still few in number. However, by selecting for study the month of July, during which the heat equator is thrown farthest to the north, this lack of data in the Southern Hemisphere is largely remedied. During July there is a nearer approach to similarity in the distribution of land and water to the north and south of the heat equator; hence the conditions which largely influence temperature and pressure changes are more nearly comparable in the Western Hemisphere than they are over the Eastern Hemisphere, where the northern half is mostly land and the southern mostly water.

Until recently the question of the diurnal variation of the barometer has been studied mostly by means of the diurnal curve at isolated stations. In the present treatment of the subject the hourly values, or rather the hourly departures from the average for the day, at about 50 stations have been charted, after being reduced to a common hour, namely, seventy-fifth meridian time. In this way we obtain a view of actual conditions of pressure at the same instant of time over a wide area, similar to that of our daily simultaneous weather charts. Charting the observations in this manner brings to light some relations hitherto but vaguely recognized in the theoretical discussions of the subject.

On the accompanying Charts X–XIII, figs. 1–24, I have plotted the departures from the average daily pressure for each hour of the day and night at stations in North and South America and in the West Indies, together with a few outlying stations. Lines were then drawn connecting stations having equal departures from the accepted normal value for the day, i. e., hourly isoabnormals of pressure. The area covered by the observations extends in longitude from 0° to 140° west of Greenwich; in latitude, from 60° north to 40° south.

Taking up the charts in the order of time, the three most striking features within the area of observation are:

(*a*) The development and westward propagation of an area of pressure above the normal, an anticyclonic area, or perhaps more properly a *wave* of increasing pressure, over the North and South American continents during the forenoon; followed by,

(*b*) The development and westward propagation of an area of pressure below the normal value, or a wave of diminishing pressure during the afternoon; followed by,

(*c*) A period of comparatively uniform distribution of pressure during the night hours, which, upon further study, may be subdivided into two minor periods, namely, a secondary period of high pressure during the first half of the night, followed by a secondary period of low pressure during the second half of the night.

A closer study of the charts under consideration reveals the following characteristics of the principal and the secondary systems of isoabnormals.

(1) The principal area of high pressure.

The area of pressure above the normal of the day appears upon the eastern coast of the United States between 5 and 6 a. m. It increases in extent and strength to 11 a. m. (seventy-fifth meridian), when it reaches a maximum, in July, of about + 0.040 inch over the United States, and of + 0.020 inch over the Gulf of Mexico and the West Indies. Over the South American Continent a maximum of + 0.040 inch is reached about an hour earlier. At the time of maximum development it extends from about 20° to 140° longitude west of Greenwich, and from about 70° north to 60° south latitude, the axis of

[1] Read before the Milwaukee Convention of United States Weather Bureau Officials, August 27, 1901.

the wave being in a NW.-SE. line through the center of the continental areas of the Western Hemisphere. The last traces of the area pass beyond the Pacific coast of the United States about 4 p. m. The entire area passes a given meridian in about eight hours.

(2) The principal area of low pressure.

The principal area of low pressure immediately follows the principal area of high pressure. It appears upon the eastern coast of the United States about 1 p. m., attains a maximum development in the United States at 6 p. m. (seventy-fifth meridian) with a departure of —0.040 inch, and leaves the Pacific coast between 11 p. m. and midnight, the entire area passing a given meridian in about eight hours. Over South America it attains its greatest depth of about —0.060 inch at 5 p. m. (seventy-fifth meridian). In geographic extent, at the time of greatest development, the diameter of the low area measures about 8,000 miles, being equal in area to the high pressure system. The development of low pressure is greatest over the central continental areas during July.

(3) The secondary area of high pressure.

The principal low pressure area is followed during the first half of the night by a secondary area of high pressure, feebly developed over the North American continent during July, but quite well marked over the colder southern continent. Its greatest development is attained between 10 p. m. and 11 p. m. (seventy-fifth meridian), when it covers the entire South American continent and adjacent portions of the Atlantic and Pacific oceans and the eastern portion of the United States. The maximum departure is about +0.030 inch. In geographic extent it has about one-half the area of the primary systems.

(4) The secondary area of low pressure.

The secondary area of high pressure is followed by a secondary area of low pressure. It is equal in geographic extent and in the degree of its development to the secondary area of high pressure, and is most evident about 4 a. m., when it prevails over all of South and North America, with a maximum depression of about —0.020 inch.

The position of the center of the diurnal departure of pressure depends upon the season of the year and upon the relative distribution of land and water.

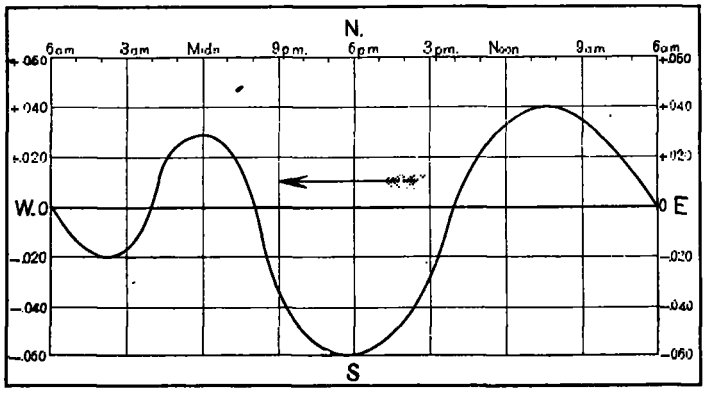

FIG. 1.

The westward propagation of the four areas is represented diagramatically in fig. 1, but is more clearly shown on Charts X–XIII, figs. 1–24.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Manuel E. Pastrana, Director of the Central Meteorologic-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the Boletin Mensual. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means are now reduced to standard gravity.

Mexican data for November, 1901.

Stations.	Altitude.	Mean barometer.*	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inch.*	°F.	°F.	°F.	%	*Inch.*		
Chihuahua	4,669	25.34	80.6	37.4	58.3	59	.....	e.	.....
Guadalajara (Obs del. Est.)	5,186	24.99	78.8	48.2	61.5	59	0.15	n.	.....
Guanajuato	6,640	23.71	84.0	36.1	60.4	55	1.15	ene.	.....
Leon (Guanajuato)	5,906	24.32	77.7	35.2	59.0	67	0.37	nw.	.....
Mazatlan	25	29.91	88.0	65.8	75 9	75	.....	nw.	.....
Merida	50	30.03	90.5	52.7	68.4	77	0.38	ne.	.....
Mexico (Obs. Cent.)	7,472	23.06	72.7	39.2	55.8	63	0.54	n.	ne.
Monterrey (Sem.)	1,626	28.30	93.2	44.6	64.9	73	1.32	ne-e.	.....
Morelia (Seminario)	6,401	23.97	74.5	41.2	59.5	71	0.43	e,	.....
Puebla (Col. Cat.)	7,125	23.39	73.4	42.8	59.2	69	1.02	e.	.....
Puebla (Col. d. Est.)	7,118	23.36	75.2	37.9	55.8	65	1.15	ene.	.....
Queretaro	6,070	24.20	79.7	37.9	59.7	63	1.35	e.	.....
Saltillo (Col. S. Juan)	5,399	24.83	75.2	42.8	56.8	76	0.24	n.	.....
S. Isidro (Hac.de Gto)	.....	.....	72.5	55.4	.....	.....	0.54	w.	.....
Toluca	8,812	21.96	72.5	32.5	51.1	65	0.65	n.	.....

*Reduced to standard temperature and gravity.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

Meteorological observations at Honolulu, November, 1901.

The station is at 21° 18′ N., 157° 50′ W.

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m., Greenwich time, or 2.29 a. m., Honolulu time.						Sea-level pressures.		Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.			
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†			‡	‡			§			
1	29.95	71	69	84	70	70.5	79	se-ne.	1	5	30.03	29.94	0.00
2	29.91	70	67.3	82	70	68.0	78	nne.	1-0	2	29.99	29.90	0.00
3	29.94	67	66.3	81	66	69.0	84	sse-n.	1	1-8	29.98	29.89	0.03
4	29.96	71	69	80	67	67.7	86	n.	1-0	6-1	30.01	29.98	0.08
5	29.94	74	68	80	68	67.3	77	nne.	1-3	7-3	30.02	29.93	0.28
6	29.93	75	68.5	81	72	66.5	72	ne.	3-5	7	29.99	29.89	0.12
7	29.90	70	69.3	80	71	66.7	72	ne.	3-5	6	29.98	29.90	0.80
8	29.90	74	69	76	69	68.5	86	ene.	4-5	9	29.94	29.86	0.78
9	29.95	75	69.5	79	72	68.0	77	ne.	5-6	8	30.00	29.89	0.41
10	30.00	76	70	77	74	67.0	76	ene.	4	10	30.04	29.96	0.37
11	29.98	74	71	79	73	68.0	76	ne.	4-6	10	30.04	29.95	0.03
12	29.99	74	69	79	73	68.7	77	ne.	5-4	10-3	30.04	29.97	0.04
13	30.00	72	66.5	78	73	68.0	78	ne.	5-4	8	30.04	29.95	0.00
14	30.05	71	63.5	77	72	65.0	74	nne.	3	10	30.06	29.96	0.27
15	30.07	73	64.5	76	68	60.7	65	ne.	5	9-6	30.13	30.06	0.01
16	30.04	74	65.5	77	69	61.7	65	ne.	5	4	30.13	30.03	0.00
17	30.02	74	66.5	77	71	63.3	68	ne.	4	6	30.07	29.97	0.03
18	30.04	72	68	78	73	64.0	68	ne.	5-4	4	30.07	29.99	0.03
19	30.05	74	70	79	70	67.0	78	ene.	3-1	6-3	30.11	30.01	0.01
20	30.04	70	68.5	80	70	69.0	78	ene.	3	4	30.09	29.99	0.00
21	30.01	67	65.7	81	68	68.3	83	nne.	1	1-4	30.07	29.97	0.00
22	29.99	72	68	80	66	66.0	78	ne.	1	2-6	30.03	29.94	0.00
23	30.01	72	69	80	66	66.7	75	ne.	2	6-3	30.05	29.96	0.02
24	30.01	74	68	79	70	66.7	77	ne.	2	6-3	30.07	29.98	0.00
25	29.98	72	67.5	79	72	64.0	68	ne.	3-2	3	30.07	29.96	0.00
26	29.97	68	65	77	68	66.3	79	nne.	1	6-8	30.02	29.95	0.01
27	29.90	69	66.5	78	63	63.3	74	n.	1	1-10	29.99	29.89	0.00
28	29.88	65	63.7	79	65	61.5	79	n.	1-0	2-6	29.95	29.85	0.02
29	29.90	66	65.3	79	63	65.3	83	n.	1-0	0-4	29.93	29.85	0.00
30	29.95	65	63.7	79	65	66.0	84	w.	1-0	7-0	29.97	29.87	0.00
Sums.	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	3.34
Means.	29.975	71.4	67.4	78.9	69.0	66.2	76.5	.....	2.6	5.5	30.030	29.939	.....
Departure.	+.026	.....	.....	.....	.....	+0.5	+0.5	.....	.....	+0.9	.....	.....	.....

*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:31 p. m., Greenwich time. ‡These values are the means of (6+9+2+9)÷4. §Beaufort scale.

Mean temperature for November, 1901 (6+2+9) = 73.9; normal is 73.8. Mean pressure for November, 1901 (9+3)÷2 = 29.983; normal is 29.957.